DOCUMENT RESUME

ED 333 006 TM 016 328

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TITLE Student Motivation and Self-Regulated Learning: A LISREL Model.
SPONS AGENCY Office of Educational Research and Improvement (ED), Washington, DC.
PUB DATE Apr 91
CONTRACT OERI-86-0010
NOTE 22p.; Paper presented at the Annual Meeting of the American Educational Research Association (Chicago, IL, April 3-7, 1991).
PUB TYPE Reports - Research/Technical (143) -- Speeches/Conference Papers (150)

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS *Academic Achievement; Behavior Patterns; *College Students; Comparative Analysis; Higher Education; *Learning Processes; *Models; Self Efficacy; *Self Motivation; *Student Motivation
IDENTIFIERS LISREL Computer Program; *Self Regulated Learning

ABSTRACT

An attempt was made to build a structural model of the relationships over time among intrinsic motivation, self-efficacy, and self-regulated learning. Structural equation modeling using the LISREL computer program was used. The presented model put the motivational constructs of intrinsic motivation and self-efficacy as temporally preceding self-regulated learning (defined as a behavioral constellation of monitoring, elaboration, and effort management strategies). Intrinsic motivation at the beginning of a college semester (Time 1) was conceptualized as directing behaviors and sense of efficacy; strategic behaviors were considered to influence both motivational constructs at the end of a college semester (Time 2). The results of a study with 367 college students who completed measures of motivational beliefs and strategies (the Motivated Strategies for Learning Questionnaire) indicate that intrinsic motivation and self-efficacy had substantial effects on self-regulated learning, and intrinsic motivation had a strong effect on self-efficacy. While self-regulated learning at Time 1 had a small positive effect on intrinsic motivation at Time 2, self-regulated learning had no effect on self-efficacy at Time 2. The results suggest that an orientation to learning and mastery results in higher levels of efficacy and deeper cognitive engagement. A subject's belief in his or her capabilities was more likely to lead to higher levels of self-regulated learning. Four tables and one figure illustrate the discussion. (Author/SLD)

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Student Motivation and Self-Regulated Learning: A LISREL Model

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Funding for the research presented in this paper was provided by a grant awarded to the National Center to Improve Postsecondary Teaching and Learning (NCRIPTAL) from the Office of Educational Research and Improvement (OERI), Department of Education (Grant # OERI-86-0010). The opinions expressed in this paper are not the positions or policies of NCRIPTAL, OERI, or the Department of Education. Paper presented at the annual meeting of the American Educational Research Association, Chicago, IL (1991, April).

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ABSTRACT

This study is an attempt to build a structural model of the relationships between intrinsic motivation, self-efficacy, and self-regulated learning. The basic question addressed is: what are the relationships over time between intrinsic motivation, self-efficacy, and self-regulated learning? The model presented in this paper puts the motivational constructs of intrinsic motivation (self-reports of value, interest, and importance) and self-efficacy (evaluations of one's perceived competence and expectations for success) as temporally preceding self-regulated learning (here, defined as a behavioral constellation of monitoring, elaboration, and effort management strategies). In accordance with traditional motivational literature, we see intrinsic motivation at time 1 directing behaviors and sense of efficacy. Following more recent research on the dynamic interplay between motivation and cognition, we allow for strategic behaviors to impact upon both motivational constructs at time 2.

We found that for college students (N=367), intrinsic motivation and self-efficacy had substantial effects upon self-regulated learning, and that intrinsic motivation had a strong effect on self-efficacy. With regard to our synergy hypothesis, we found that while self-regulated learning at time 1 had a small positive effect on intrinsic motivation at time 2, self-regulated learning had no direct or indirect effect on self-efficacy at time 2. The results suggest that adopting an orientation to learning and mastery results in higher levels of efficacy and deeper levels of cognitive engagement in self-regulated learning. In addition, believing that one is capable is more likely to lead to higher levels of self-regulated learning.

STUDENT MOTIVATION AND SELF-REGULATED LEARNING: A LISREL MODEL

There has been much research done on motivation in education, and on the use of strategies in learning, but the interface between the two has only just begun to be addressed by researchers. Pintrich and his colleagues (Pintrich, 1988a,b, 1989; Pintrich, Cross, Kozma, & McKeachie, 1986; Pintrich & DeGroot, 1990; Pintrich & Garcia, 1991, in press) have directed their research towards exploring the dynamic interplay between motivation and cognition. These researchers argue that it is important to integrate motivational as well as cognitive components of student learning to fully understand the learning process: a conceptualization that does not address this dynamism is lacking in predictive validity. They have found that motivational and cognitive components were positively correlated: that is, higher levels of motivation were associated with higher levels of cognitive engagement. Additionally, motivation and cognitive engagement were positively related to academic achievement. Pintrich (1989) argues that the relationship between motivation and cognition is not simply dynamic, but synergistic: the effect of the interaction between motivation and cognition is greater than their individual effects. The cooperative nature of the relationship between motivation and cognition is a crucial aspect of student learning.

We take our definition of self-regulated learning from the research of Corno and her colleagues (Corno, 1989; Corno & Mandinach, 1983; Corno & Rohrkemper, 1985): of self-regulated learning as a set of learning strategies (monitoring, elaboration, and effort-management) that a student can use, allowing her to effectively and flexibly approach a learning task. These researchers posit a relationship between motivation and self-regulated

learning as well. Corno & Rohrkemper propose that engaging in self-regulated learning leads to a sense of personal responsibility and a sense of competence: these are two key factors in the intrinsic motivation to learn. By engaging in self-regulated learning, intrinsic motivation is optimized; intrinsic motivation, in turn, impacts upon future strategic use.

In the same vein, Zimmerman (1989) and Schunk (1989), working within a social-cognitive perspective, propose a similar conceptualization of self-regulated functioning. A reciprocal triadic causation between behaviors, environmental variables, and cognitions/personal factors is hypothesized. These researchers use the construct of self-efficacy as a key personal factor in their view of self-regulated functioning: they too see an interplay between motivation and cognition. Self-efficacy has consistently been found to be positively related to effective use of strategies as well as academic success (e.g., Schunk, 1985).

We have focused on cognitive and personal factors in this study, and limited our analysis to the relationships between intrinsic motivation, self-efficacy, and self-regulated learning through an academic semester. We see intrinsic motivation as "triggering" the process: students' perceptions of value, importance, and interest impact upon their use of learning strategies and their evaluations of competence and expectancies for success. Self-efficacy also mediates self-regulated learning. In order to address the synergy hypothesis presented above, we examined the effects of self-regulated learning at time 1 on intrinsic motivation and self-efficacy at time 2. We expected positive relationships between all these constructs: but we were interested in specifying in a causal model the dynamic interplay between motivation and cognition.

METHODOLOGY

Subjects. Subjects were 367 college students in eleven classes and three disciplines: biology, English, and social science. These classrooms were sampled from three midwestern institutions: a community college, a small, private four-year college, and a large public four-year university. The gender breakdown was 55% female, 45% male. The majority of the students were in their first year of college (53.9%).

These data were collected on a volunteer basis during the winter 1988 term. Subjects received no monetary compensation for their participation. The classes were visited twice, once at the onset of the semester (time 1, about 2-3 weeks into the semester) and again at the end of the semester (time 2, approximately 2 weeks before the end of the term). The Motivated Strategies for Learning Questionnaire (MSLQ) was administered at each visit.

Measures. The Motivated Strategies for Learning Questionnaire (Pintrich, McKeachie, Smith, Doljanac, Lin, Naveh-Benjamin, Crooks, and Karabenick, 1988) is a self-report, Likert-scaled (1=not true of me, to 7=very true of me) instrument designed to measure student motivational beliefs and strategy use. The 1988 version of the MSLQ consisted of 40 motivation and 65 cognitive strategy items.

Thirty items were selected to tap into our three constructs: intrinsic motivation; self-efficacy; and self-regulated learning. Intrinsic motivation has four indicators; self-efficacy five; and self-regulated learning six indicators. Pretest alphas for these constructs were .88, .85, and .77 for intrinsic motivation/value, self-efficacy, and self-regulated learning, respectively. Corresponding posttest internal reliability coefficients were .91, .88, and .79. A

listing of the items is located in Table 1. Scale means, standard deviations, and zero-order correlations are presented in Table 2.

Insert Table 1 about here

Insert Table 2 about here

Method. In order to make a stronger causal statement of the relationships between these three constructs, pretest and posttest data were used. A multiple time point sampling adds to the robustness of a quantitative statement of a theory: issues of model specification can be better addressed with longitudinal data (Nesselroade & Baltes, 1979). While a two-time point sampling has its limitations (Rogosa, 1979), a causal statement made with data taken from the same sample over different points in time is more powerful than one based upon a single sampling.

Structural equation modeling using LISREL VI (Joreskog & Sorbom, 1986), rather than path analysis was used in this study. Since pretest and posttest data were being used, multiple regression's assumption of uncorrelated error terms was clearly violated; LISREL allows the researcher to correlate residuals between the variables being used. Another advantage of LISREL over multiple regression is that in using latent variables, one is able to incorporate measurement error in one's model: multiple regression assumes perfectly measured variables, and perfect measurement of variables is rarely, if ever, found in social science research.

Model specification. The effects of these six latent variables (three at time 1 and three at time 2) are modeled in Figure 1. We are essentially examining three sets of relationships: those between the three constructs **within the pretest**, those between the three constructs **within the posttest**, and the effect of these constructs **between the pretest and posttest**.

The relationships between intrinsic motivation, self-efficacy, and self-regulated learning are modeled the same way within the pretest and within the posttest. Intrinsic motivation has a direct impact upon self-efficacy and self-regulated learning. Self-efficacy also impacts upon self-regulated learning. In other words, we are saying that self-regulated learning is affected by both intrinsic motivation and self-efficacy; self-efficacy being in part determined by intrinsic motivation.

As for the pretest-posttest linkages, we drew direct paths between each pair of pretest and posttest constructs: i.e., between intrinsic motivation 1 and intrinsic motivation 2; self-efficacy 1 and self-efficacy 2; self-regulated learning 1 and self-regulated learning 2. Instead of drawing all possible paths between the six latent variables, we constrained the model and simply obtained estimates of the effects of self-regulated learning at the pretest on posttest intrinsic motivation and self-efficacy. Our hypothesis was that motivation "triggered" the process, but once self-regulated learning was initiated, it would in turn, impact upon motivation: a synergistic effect between these constructs was proposed (see Pintrich, 1989).

Insert Figure 1 about here

Several parameters were constrained to fixed values. The error term (psi estimate) for intrinsic motivation at time 1 was fixed to 1.0, as it is the only exogenous variable in the model. The linkages between the pretest and posttest pairs of constructs were constrained to be equal, as there was no theoretical basis for assuming differences in impacts between these variable pairs from time 1 to time 2. The error terms for self-efficacy 2 and self-regulated learning 2 were fixed at .4 and .3 respectively. This was done to avoid problems with model identification. Other values for these latter two fixed parameters were used to examine differences in goodness of fit between models. Model comparisons showed this to be the most robust version.

RESULTS

Omnibus fit statistics. Omnibus fit statistics indicate that this model is a robust representation of the relationships found in the input data. The chi-squared value for the model is 803.33, calculated on 408 degrees of freedom. Five fit statistics were calculated: the GFI, AGFI, RMR, CN, and the X^2/df ratio. The X^2/df ratio is 1.97; a ratio of less than 5 is considered to be indicative of good fit between the observed and reproduced correlation matrices (Hayduk, 1987). The goodness of fit statistic (GFI) and adjusted goodness of fit statistic (AGFI) are .87 and .85, respectively. While estimates of .9 and above are more desirable, these are nevertheless reasonable values. The root mean residual (RMR) is acceptably low: .07. Hoelter's critical number (CN) for this model is 209, which exceeds the heuristic cutoff value of 200 (Hoelter, 1983).

Within-pretest relationships. The within-pretest parameter estimates show that intrinsic motivation and self-efficacy have substantial positive effects upon self-regulated learning. Standardized beta estimates are .36 and .38 respectively. Intrinsic motivation's effect on self-efficacy is comparably strong (.33).

Within-posttest relationships. The within-posttest parameter estimate show slightly different effects between the three constructs. While intrinsic motivation and self-efficacy at time 2 (as in time 1) have impacts similar in magnitude upon self-regulated learning at time 2, these estimates are lower than those at the pretest (.24 for intrinsic motivation and .26 for self-efficacy). Intrinsic motivation's effect on self-efficacy remains stable between the pretest and the posttest (.33 at time 1 and .36 at time 2).

Between pretest-posttest relationships. Not surprisingly, the strongest linkages between the pretest and posttest were between the pretest and posttest versions of the same construct. The most intriguing finding here was that while self-regulated learning at time 1 had a small positive effect upon intrinsic motivation/value at time 2 (.14), it had no net effect upon posttest self-efficacy (-.04). The indirect effect of self-regulated learning on self-efficacy (via posttest intrinsic motivation) was also weak (.05).

Insert Table 3 about here

Insert Table 4 about here

CONCLUSIONS

The two motivational constructs, intrinsic motivation and self-efficacy, had strong positive impacts of similar magnitudes upon self-regulated learning. This is in accordance with correlational studies carried out in the past several years (e.g., Pintrich, 1989; Pintrich & DeGroot, 1990; Pintrich & Garcia, 1991, in press). Motivation has a direct impact upon cognitive engagement: adoption of a learning and mastery orientation and positive evaluations of competence lead to greater use of monitoring, elaboration, and effort management strategies.

The betas between intrinsic motivation and self-regulated learning, and self-efficacy and self-regulated learning at the posttest are lower than their corresponding links at the pretest. It is likely that other factors were influencing posttest self-regulated learning. Self-regulated learning, as we have defined it, is a set of effortful, cognitively demanding strategies. End-of-term time constraints, for example, would impact upon the degree of self-regulated learning reported by students, above and beyond their levels of intrinsic motivation and self-efficacy at the posttest. Students may simply not have the time to allocate to be cognitively engaged throughout the term.

Intrinsic motivation has a strong positive effect upon self-efficacy; this relationship holds true for both time 1 and time 2 measures. Students' adoption of a general learning and mastery orientation plays a significant role in their perceptions of self-competence and succeeding in their courses. This finding is in line with Dweck and Leggett's (1988) model that proposes that the adoption of a learning goal leads to positive efficacy beliefs and attributions.

We also hypothesized that intrinsic motivation and self-efficacy at time 2 would be affected by self-regulated learning at time 1. That is, that there is a dynamic, synergistic relationship between motivation and cognitive engagement: motivation provides the impetus to engage in different learning strategies, but use of learning strategies, or cognitive engagement, would in turn influence future levels of motivation. This synergy hypothesis was only partially supported by this model.

This model indicates that self-regulated learning at the pretest has a small positive effect on intrinsic motivation (.14) and little effect on self-efficacy at the posttest. Self-regulated learning at time 1 had no direct (beta= -.04, n.s.) or indirect (.14 x .36 = .05) effect on posttest self-efficacy. It may be that posttest self-efficacy may also be determined by factors not included in the model. Students may have also been overly optimistic at the beginning of the semester and received a "hard dose of reality" as the term progressed. Perhaps by the end of the term, students have a better idea about their level of expertise after having been given feedback on previous course assignments, exams, other classroom tasks, and so forth: this would certainly impact upon their reports of self-efficacy at the posttest. Self-efficacy may be more greatly influenced by environmental variables such as reward structure or degree of autonomy (e.g., Ames & Ames, 1984; Ryan, Connell, & Deci, 1985) than use of effortful, mindful, cognitive learning strategies. Therefore, while we found support for the proposed dynamic between motivation and cognitive engagement, cognitive engagement affected students' intrinsic motivation, but not their evaluations of competence.

These findings point to the importance of including motivational constructs in our models of self-regulated learning. Student characteristics such as intrinsic motivation and self-efficacy have been shown to have

substantial impacts upon self-regulated learning. Self-regulated learning, in turn, leads to higher levels of intrinsic motivation. The impact of self-regulated learning on self-efficacy is less clear and more research is needed on this aspect of our model. Schunk (1989) and Zimmerman (1989) have both proposed a reciprocal triadic causation between the person (cognitions/beliefs), the person's actions, and the environment. What we have done here is focus upon the relationship between <u>two</u> of the three elements. As discussed above, intrinsic motivation, and especially self-efficacy, may be strongly affected by variables not included in this model, such as reward structure, grouping practices, perceptions of autonomy and teacher support. The inclusion of environmental variables would likely enhance this model, and our future research will address environmental influences on motivation and cognitive engagement.

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Table 1. Intrinsic motivation, self-efficacy, and self-regulated learning: Indicators for the latent variables. Taken from the Motivated Strategies for Learning Questionnaire (Pintrich et al., 1988). N=367, pairwise deletion of missing data.

Intrinsic Goal Orientation/Value

v119,719	I am very interested in the content area of this course.
v124,724	My main goal in this course is to learn a great deal about the subject.
v125,725	I think the course material in this course is useful for me to learn.
v129,729	Understanding the subject matter of this course is important to me.

Self-Efficacy

v107,707	I'm certain I can understand the most difficult material presented in the readings for this course.
v113,713	I'm confident I can learn the basic concepts taught in this course.
v122,722	I'm confident I can do an excellent job on the assignments and tests in this course.
v132,732	I'm certain I can master the skills being taught in this class.
v138,738	I'm confident I can understand the most complex material presented by the instructor in this course.

Self-Regulated Learning

v145,745	When I become confused about something I'm reading, I go back and try to figure it out.
v152,752	I work hard to get a good grade even when I don't like a course.
v173,773	I try to understand the material in this class by making connections between the readings and the concepts from the lectures.
v178,778	Even when course materials are dull and uninteresting, I manage to keep on working until I finish.
v185,785	I try to apply ideas from course readings in other class activities such as lecture and discussion.
v196,796	When I study a topic I try to make everything fit together.

Table 2. Descriptive statistics and zero-order correlations for pretest and posttest measures of intrinsic motivation, self-efficacy, and self-regulated learning.

	Mean [SD]	r with Intrinsic Motivation (time 1)	r with Self-Efficacy (time 1)	r with Self-Reg. Learning (time 1)	r with Intrinsic Motivation (time 2)	r with Self-Efficacy (time 2)
Intrinsic Motivation (time 1)	5.62 [1.04]	1.0				
Self-Efficacy (time 1)	5.51 [.91]	.29	1.0			
Self-Reg. Learning (time 1)	5.53 [.85]	.38	.39	1.0		
Intrinsic Motivation (time 2)	5.23 [1.26]	.59	.19	.30	1.0	
Self-Efficacy (time 2)	5.32 [1.07]	.19	.55	.32	.42	1.0
Self-Reg. Learning (time 2)	5.27 [.97]	.28	.25	.66	.46	.48

Table 3. Standardized beta estimates.

	Intrinsic Motivation (time 1)	Self-Efficacy (time 1)	Self-Reg. Learning (time 1)	Intrinsic Motivation (time 2)	Self-Efficacy (time 2)
Self-Efficacy (time 1)	.33				
Self-Reg. Learning (time 1)	.36	.38			
Intrinsic Motivation (time 2)	.53		.14		
Self-Efficacy (time 2)		.53	-.04	.36	
Self-Reg. Learning (time 2)			.53	.24	.26

Table 4. Correlations between latent variables (phi estimates).

	Intrinsic Motivation (time 1)	Self-Efficacy (time 1)	Self-Reg. Learning (time 1)	Intrinsic Motivation (time 2)	Self-Efficacy (time 2)
Self-Efficacy (time 1)	.33				
Self-Reg. Learning (time 1)	.49	.50			
Intrinsic Motivation (time 2)	.60	.25	.40		
Self-Efficacy (time 2)	.37	.60	.37	.47	
Self-Reg. Learning (time 2)	.51	.48	.73	.58	.58

Figure 1. A pretest-posttest model of the effects of intrinsic motivation, self-efficacy, and self-regulation upon one another. Standardized parameter estimates are shown. N=367.